LUMEL

METER
OF NETWORK
N14 TYPE

USER'S MANUAL

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1. APPLICATION

The N14 meter is a programmable digital panel instrument destined for the measurement of 3-phase, 3 or 4-wire power network parameters, in balanced or unbalanced systems with the simultaneous display of measured quantities and digital transmission of their values.

This network parameter meter enables the control and optimization of power electronic devices, systems and industrial installations.

The N14 meter ensures the measurement of: RMS voltage and current, active, reactive and apparent power, active and reactive energy, power factors, frequency, mean active power (e.g. 15-min mean power).

Voltages and currents are multiplied by given current and voltage ratios of measuring transformers. Indications of power and energy take into consideration programmed ratio values.

The value of each measured quantity can be transmitted to the master system through the RS-485 interface.

The relay output signals the exceeding of the chosen quantity and the impulse output can be used for the consumption control of the 3-phase active energy.

The meter is fixed to the panel by means of screw holders.

2. METER SET

The meter set includes:

- N14 meter 1 pc
- user's manual 1 pc
- guarantee card 1 pc
- holder to fix the meter in a panel 2 pcs

When unpacking, please check the completeness of the set.

3. BASIC REQUIREMENTS AND OPERATIONAL SAFETY

In the security scope, the meter meets the requirements of EN 61010-1 standard.

Remarks concerning the operator safety:

- All operations concerning the meter installation and connections should be carried out by qualified skilled personnel and national regulations for the prevention of accidents must be observed.
- Before connecting the meter to the power, one must check the correctness of connections.
- Do not connect the meter to the network through an autotransformer.
- Before the removal of the meter housing, one must disconnect its supply and all measuring circuits.
- The housing removal from the meter during the guarantee contract causes its cancellation.
- The meter fulfils requirements concerning the electromagnetic compatibility in the industrial environment.
- In the building installation should be a switch or a circuit breaker, situated near the meter, easy accessible for the operator and suitably marked.

4. MOUNTING

The meter is adapted to be mounted in a panel by means of holders acc. to fig.1.

The meter housing is made of a self-extinguishing plastics. Meter dimensions: $96 \times 96 \times 70.5$ mm. One must prepare a hole of $91^{+0.5} \times 91^{+0.5}$ mm in the panel which the thickness should not exceed 6 mm.

The meter must be introduced from the panel front with disconnected supply voltage. At the rear side of the meter there are terminal strips which enable the connection of wires up to 2.5 mm^2.

After the insertion into the hole, fix the meter by means of two holders.

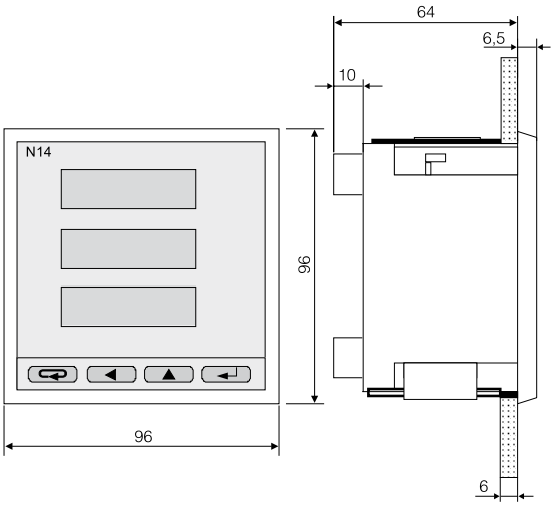


Fig. 1. Overall meter dimensions

5. METER DESCRIPTION

5.1. Current inputs

All current inputs are galvanically isolated (internal current transformers).

The meter is adapted to co-operate with external current transformers.

Displayed current values and derived quantities are automatically re-counted by the quantity of the introduced external transformer ratio. Current inputs are defined in the order as 1 A or 5 A.

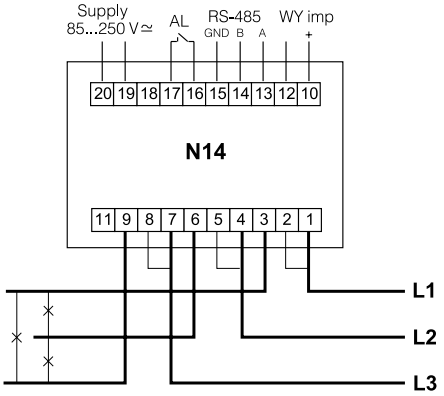
5.2. Voltage inputs

Quantities on voltage inputs are automatically recounted by the quantitiy of the introduced external voltage transformer ratio.

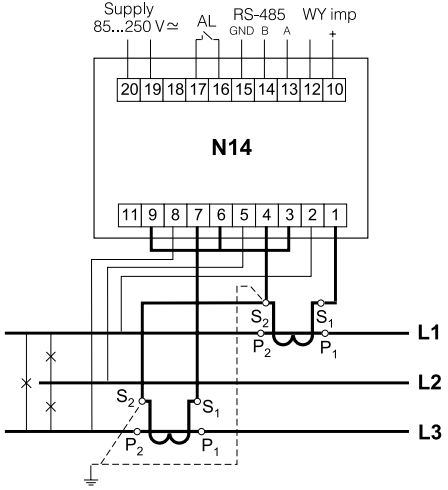
Voltage inputs are defined in the order as 3 x 57.7/100 V, 3 x 230/400 V or 3 x 400/690 V.

5.3. Connection diagrams

Direct measurement in a 3-wire network



Semi-indirect measurement in a 3-wire network



Indirect measurement with the use of 2 current transformers and 2 or 3 voltage transforme3rs in a 3-wire network.

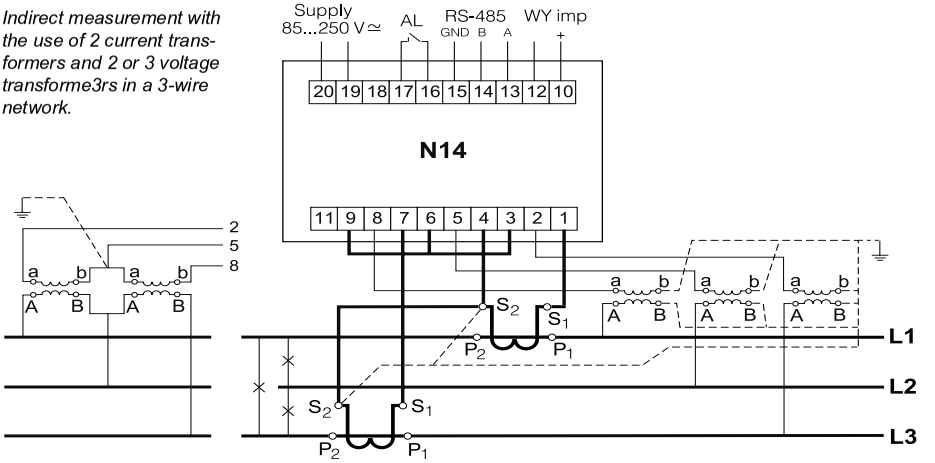
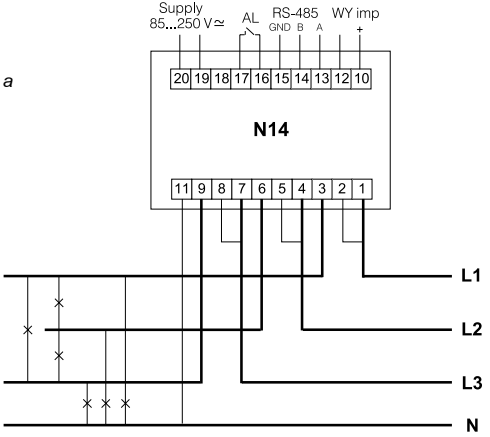
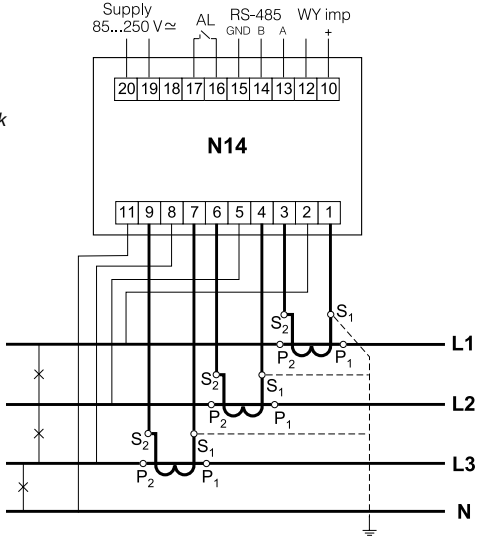


Fig. 2 Meter connection diagrams in a 3-wire network

Direct measurement in a 4-wire network



Semi-indirect measurement in a 4-wire network



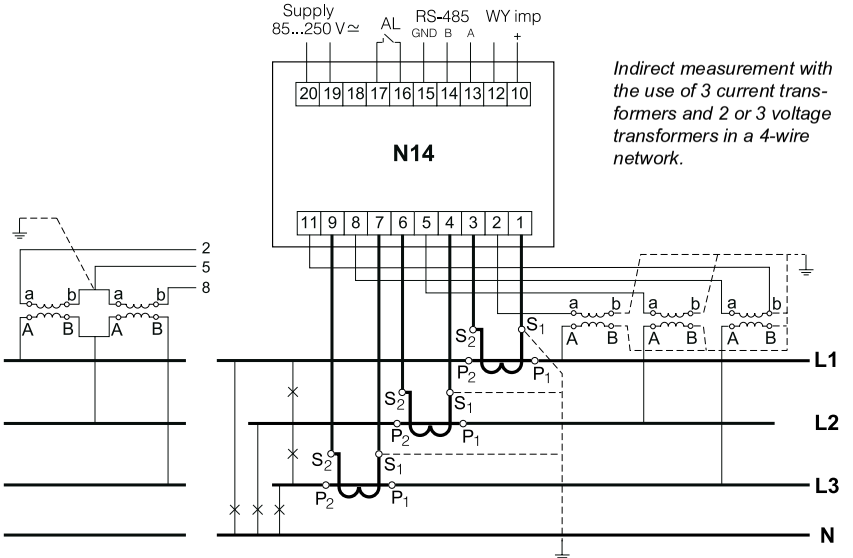


Fig. 3 Meter connection diagrams in a 4-wire network

6. N14 PROGRAMMING

6.1. Frontal panel

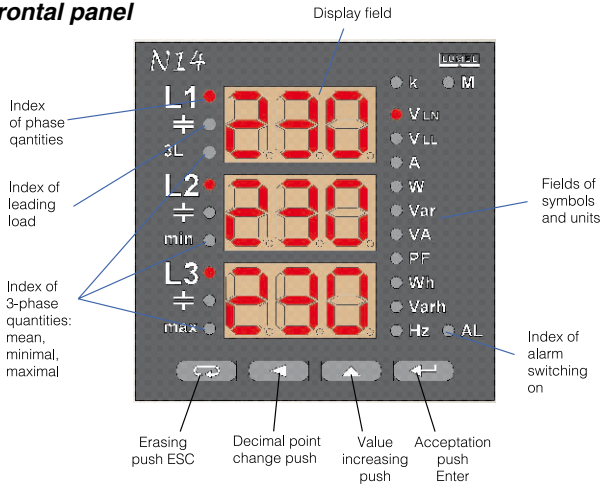


Fig. 4 Frontal panel

6.2. Messages after switching the supply on

After switching the supply on, the meter carries out the display test and displays the name of the N14 meter and the current program version.

Where: n.nn is the number of the current program version or the number of a custom-made version.

Caution! If at the moment of the start, the message Err Cal lub Err EE appears, one must contact an authorized service.

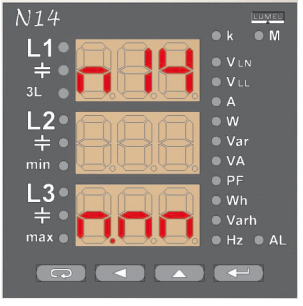


Fig.5. Message after the meter start

6.3. Working modes

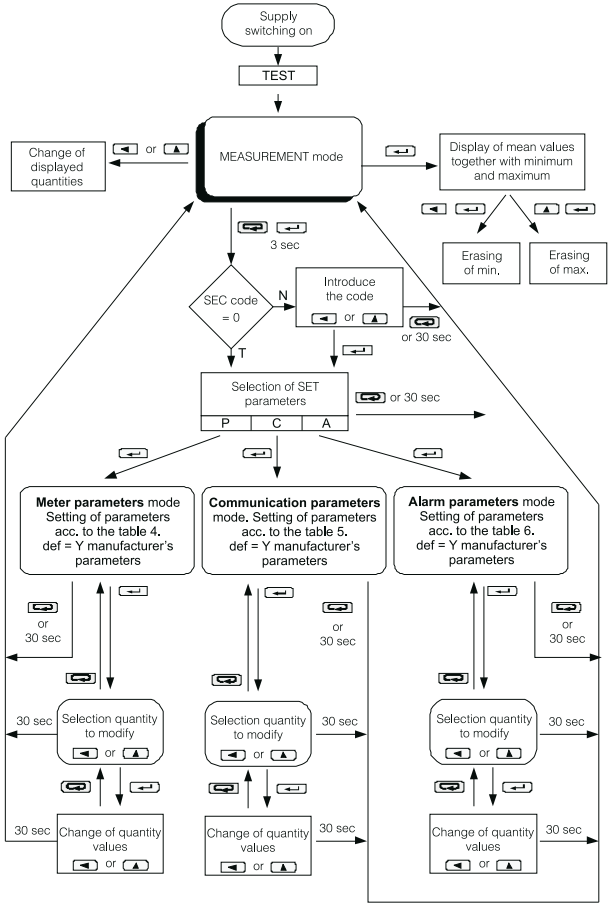

Supply switching on
TEST
MEASUREMENT mode
Change of displayed quantities
or
Display of mean values together with minimum and maximum
Erasing of min.
Erasing of max.
3 sec
SEC code = 0
N
T
Introduce the code
or
or 30 sec
Selection of SET parameters
P
C
A
or 30 sec
Meter parameters mode Setting of parameters acc. to the table 4. def = Y manufacturer's parameters
Communication parameters mode. Setting of parameters acc. to the table 5. def = Y manufacturer's parameters
Alarm parameters mode Setting of parameters acc. to the table 6. def = Y manufacturer's parameters
or 30 sec
30 sec
Selection quantity to modify
Change of quantity values

Fig.6. Working modes of N14 meter

6.4. Parametr preview

Quantities are displayed in the measurement mode acc. to the settled tables. The pressure of the [◄] (left) or [▲] (top) causes the transition between displayed quantities.

The preview of 3-phase values: mean, minimal and maximal is accessible after pressing the acceptation [↵] (Enter) push. During the preview of these values, the pressure of the [◄] (left) push cancels minimal values, however the [▲] (top) push, maximal values.

Accessible measuring quantities

Basic quantities (L1, L2, L3 indexes are backgroung lighted)

Table 2

Symbol indexes are background lighted		VLN	VLL	A	W	Var	VA	PF	kWh	kVarh	Hz	Wh (15 min)
Values displayed in:	row 1	U1	U12	I1	P1	Q1	S1	PF1			f1	PAu
	row 2	U2	U23	I2	P2	Q2	S2	PF2			min	min
	row 3	U3	U31	I3	P3	Q3	S3	PF3	EnP	EnQ	max	max

Mean, minimal, maximal quantities (indexes 3L, min, max are background lighted).

Table 3

Symbol indexes are background lighted		VLN	VLL	A	W	Var	VA	PF
Values displayed in:	row 1	$U_{mean\ phase}$	$U_{mean\ between\ phase}$	$I_{mean\ phase}$	$P_{mean\ phase}$	$Q_{mean\ phase}$	$S_{mean\ phase}$	$PF_{mean\ phase}$
	row 2	min	min	min	min	min	min	min
	row 3	max	max	max	max	max	max	max

At capacity load, the index showing the load character ⏚ is background lighted. The exceeding of the upper indication range is signaled on the display by upper horizontal dashes. The mean active power 15-min PAu is displayed after a full interval of the 15-min mean time. In case when the full interval of time is not expired, the message Err is displayed.

The display of errors was described in the chapter 8.

The alarm relay switching on is signaled by the AL index background lighting.

6.5. Setting of parameters

The entry in the programming mode is carried out by pressing and holding during ca 3 sec. [ ] and [ ] pushes.

The entry in the programming mode is protected by the access code. In case when there is no code, the program transits into the programming option. The inscription SET (in the first column) and symbols of respective levels **P**, **C**, **A** are displayed.

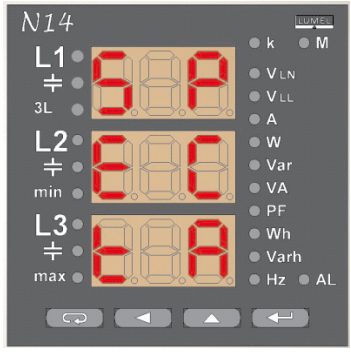


Fig. 7. Menu setup

6.5.1. Setting of meter parameters

Select the mode **P** in options (by [ ] or [ ] pushes) and confirm the choice by the [ ] push.

Table 4

Parameter name	Access code	Current ratio	Voltage ratio	Energy erasing	Erasing of 15-minut active power	Restoration of manufacturer values
Displayed information	SEC	t_I	t_U	En0	PA0	dEF
Default value	0	1	1	no	no	no
Range of changes	0...999	1...10000	1...4000	YES/no	YES/no	YES/no

Following values are set by means of [▲] and [◄] pushes: Position of the decimal digit is selected by the [◄] push, the digit value is increased by the [▲] push. The active position is signalled by the cursor. The value is accepted by the [↵] push or abandoned by pressing the [↵] push. During the acceptation, one can check if the value is contained in the range.

In case of the value setting beyond the range, the meter remains in the parameter edition mode, however the value is set on the maximal value (if the value is too high) or on the minimal value (if the value is too small).

Caution: to display and set 4 and 5-digit parameters (t_U, t_I) two lower display rows are used.

6.5.2. Setting of communication parameters

In options, select the mode **C** and confirm the choice by the [↵] push.

Table 5

Parameter name	Meter address	Interface mode	Interface rate	Restoration of manufacturer values
Displayed information	Adr	trY	bAU	dEF
Default value	1	8n2	9.6 k	no
Range of changes	1...247	8n2, 8e1, 8o1, 8n1	4.8, 9.6, 19.2, 38.4 k	YES/no

6.5.3. Setting of alarm parameters

In options, select the mode **A** and confirm the choice by the ↵ push.

Table 6

Parameter name	Monitored quantity	Kind of alarm operation	Upper switching value (in %)	Lower switching value (in %)	Time delay of the reaction (in sec.)	Restoration of manufacturer values
Displayed information	A_n	A_t	Aon	Aof	Adt	dEF
Default value	oFF	nor	101	99	0	no
Range of changes	see table 7	nor, on, oFF, hon, hoF	0...120	0...120	0...300	YES/no

Selection of monitored quantity:

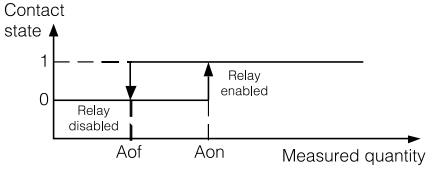
Table 7

Displayed parameter	Quantity monitored by the alarm
off	Alarm disabled
U_1	Voltage of phase 1
I_1	Current of phase 1
P_1	Active power of phase 1
q_1	Reactive power of phase 1
S_1	Apparent power of phase 1
PF1	Active power factor of phase 1
U_2	Voltage of phase 2
I_2	Current of phase 2

Table 7

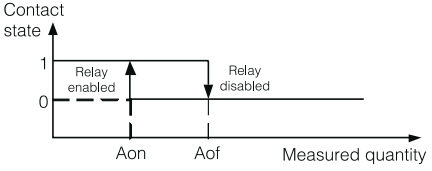
P_2	Active power of phase 2
q_2	Reactive power of phase 2
S_2	Apparent power of phase 2
PF2	Active power factor of phase 2
U_3	Voltage of phase 3
I_3	Current of phase 3
P_3	Active power of phase 3
q_3	Reactive power of phase 3
S_3	Apparent power of phase 3
PF3	Active power factor of phase 3
U_A	Mean phase voltage
I_A	Mean phase current
P	Active 3-phase power
q	Reactive 3-phase power
S	Apparent 3-phase power
PFA	Mean power factor
F	Frequency
U12	Phase-to-phase voltage between phase 1 and 2
U23	Phase-to-phase voltage between phase 2 and 3
U31	Phase-to-phase voltage between phase 3 and 1
U4A	Mean phase-to-phase voltage
PAu	Active 3-phase 15-minute power

a) **nor**



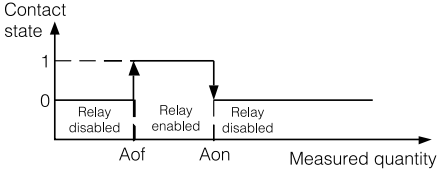
Aon > Aof

b) **nor**



Aon ≤ Aof

c) **On**



d) **OFF**

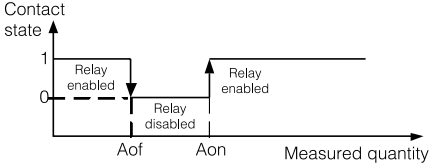


Fig. 8. Alarm types: a),b) normal c) disabled d) enabled.

Remained types of alarms: hon – always enabled; hof – always disabled.

Example of alarm setting:

Set the alarm of **nor** for **Aon > Aof**, for the monitored 3-phase active Power **P**

Version: 5 A; 3 x 230/400 V. Alarm enabled after exceeding 3800 W, alarm disabled after decreasing 3100 W.

Calculation:

rated 3-phase active Power: P = 3 x 230 V x 5 A = 3450 W

3450 W – 100% 3450 W – 100%

3800 W – Aon% 3100 W – AoF%

Therefore: Aon = 110 % AoF = 90%

Set: Monitored quantity: P; Kind of alarm: nor, Aon 110, AoF 90.

7. INTERFEJS RS-485

Set of the N14 meter serial link parameters:

- identifier 0xAC
- meter address 1...247
- baud rate 4.8, 9.6, 19.2, 38.4 kbit/s,
- working mode Modbus RTU,
- information unit 8N2, 8E1, 8O1, 8N1,
- maximal response time 1000 ms.
- Implemented functions: 03, 16, 17
  - -03 - register readout,
  - -16 - register write,
  - -17 - device identification.

Manufacturer's settings: address 1, baud rate 9600 bit/s, RTU 8N2 mode.

Register map of the N14 meter.

In the N14 meter, data are placed in 16 and 32-bit registers.

Process variables and meter parameters are placed in the address area of registers in the way dependent on the variable value type.

Bits in the 16-bit registers are numbered from the youngest to the oldest (b0-b15). 32-bit registers include numbers of float type in the IEEE-745 standard.

Table 8

Address range	Type of value	Description
4000 – 4019	Integer (16 bits)	Value placed in one 16-bit register. Description of registers are included in the table 9. Registers for write and readout.
7500 – 7555	Float (32 bits)	Value placed in one 32-bit register. Description of registers are included in the table 10. Registers for readout.

Table of 16 – bit register for N14 meter Table 9

Register address	Operations	Range	Description	Default
4000	RW	0…999	Access code to parameters	0
4001	RW	1...10000	Ratio of the current transformer	1
4002	RW	1..4000	Ratio of the voltage transformer	1
4003	RW	0,1	Erasing of watt-hour meters	0
4004	RW	0,1	Erasing of 15-minute active Power PAV	0
4005	RW	0,1	Erasing of min. and max.	0
4006	RW	0,1...30	Quantity on the relay output	0
4007	RW	0...4	Output type: 0 – nor, 1- on, 2 - oFF,3 - hon, 4 - hoFF	0
4008	RW	0...120%	Upper value of alarm switching (relay)	101
4009	RW	0...120%	Lower value of alarm switching (relay)	99
4010	RW	0...300s	Delay of alarm switching	0
4011	RW	0...247	Address in MODBUS network	1
4012	RW	0...3	Transmission mode: 0->8n2, 1->8e1, 2->8o1, 3->8n1	0

Table 9

4013	RW	0...3	Baud rate: 0->4800, 1->9600 2->19200,3->38400	1
4014	RW	0...1	Acceptation of above transmission parameters	0
4015	R	0...15258	Active energy, two older bytes	0
4016	R	0...65535	Active energy, two younger bytes	0
4017	R	0...15258	Reactive energy, two older bytes	0
4018	R	0...65535	Reactive energy, two younger bytes	0
4019	R	0...65535	Status register – description below	0

Status register:

Bit 15 – relay output state „1" – On, „0" - off
Bit 14 – „1" – FRAM damaged
Bit 13 – „1" – lack of calibration or erroneous calibration
Bit 12 – „1" – active calibration
Bit 11 – reserved
Bit 10 – „1" – the interval of power averaging does not elapse
Bit 09 – „1" –error of parameter values in FRAM
Bit 08 – „1" – error of energy value in FRAM
Bit 7 – reserved
Bit 6 – „1" – too small voltage for frequency measurement
Bit 5 – „1" – too small voltage in phase C
Bit 4 – „1" – too small voltage in phase B
Bit 3 – „1" – too small voltage in phase C
Bit 2 – current range „0" – 1 A~; 1" – 5 A~

Bit 1	Bit 0	voltage range
0	0	57,8 V~
0	1	230 V~
1	1	400 V~

Table of 32 bit registers for N14 meter Table 10

Register address	Operation	Description
7500	R	Voltage of phase L1
7501	R	Current of phase L1
7502	R	Active power of phase L1
7503	R	Reactive power of phase L1
7504	R	Apparent power of phase L1
7505	R	Active power factor of phase L1
7506	R	Ratio of reactive power/active power of phase L1
7507	R	Voltage of phase L2
7508	R	Current of phase L2
7509	R	Active power of phase L2
7510	R	Reactive power of phase L2
7511	R	Apparent power of phase L2
7512	R	Active power factor of phase L2
7513	R	Ratio of reactive power/active power of phase L2
7514	R	Voltage of phase L3
7515	R	Current of phase L3
7516	R	Active power of phase L3
7517	R	Reactive power of phase L3
7518	R	Apparent power of phase L3
7519	R	Active power factor of phase L3
7520	R	Ratio of reactive power/active power of phase L3
7521	R	Mean 3-phase voltage
7522	R	Mean 3-phase current
7523	R	3-phase active power
7524	R	3-phase reactive power
7525	R	3-phase apparent power
7526	R	Mean active power factor
7527	R	Ratio of mean reactive Power/mean active power

Table of 32 bit registers for N14 meter Table 10

7528	R	Frequency
7529	R	Phase-to-phase voltage L1-L2
7530	R	Phase-to-phase voltage L2-L3
7531	R	Phase-to phase voltage L3-L1
7532	R	Mean phase-to-phase voltage
7533	R	Mean 15-minute active power
7534	R	Reserved
7535	R	Reserved
7536	R	Mean minimal 3-phase voltage
7537	R	Mean maximal 3-phase voltage
7538	R	Mean minimal 3-phase current
7539	R	Mean maximal 3-phase current
7540	R	Minimal 3-phase active power
7541	R	Maximal 3-phase active power
7542	R	Minimal 3-phase reactive power
7543	R	Maximal 3-phase reactive power
7544	R	Minimal 3-phase apparent power
7545	R	Maximal 3-phase apparent power
7546	R	Minimal active power factor
7547	R	Maximal active power factor
7548	R	Minimal mean 3-phase reactive power factor/active power factor ratio
7549	R	Maximal mean 3-phase reactive power factor/active power factor ratio
7550	R	Minimal frequency
7551	R	Maximal frequency
7552	R	Minimal mean phase-to-phase voltage
7553	R	Maximal mean phase-to phase voltage
7554	R	Minimal mean 15-minute active power
7555	R	Maximal mean 15-minute active power

8. ERROR CODES

Messages about errors can appear during the meter operation.
Reasons of these errors are presented below.

Err - when the voltage or current is too low during the meter work:

- Pf_i, $t\varphi_i$ below 10% U_n, I_n
- f below 10% U_n
- The full time interval of power averaging PAu does not elapse.

9. TECHNICAL DATA

Measuring ranges and admissible basic errors are presented in the table 11.

Table 11

Measured value	Indication range	Measuring range	L1	L2	L3	Σ	Basic error
Current 1/5 A L1...L3	0.00...9.99 kA	0.02...6 A~	●	●	●		± 0.5%
Voltage L-N	0.0...289 kV	2.9...440 V~	●	●	●		± 0.5%
Voltage L-L	0.0...500 kV	10...760 V~	●	●	●		± 1%
Frequency	45.0...70.0 Hz	45.0...65.0 Hz	●	●	●		± 0.2%
Active power	-999 MW...0.00 W ...999 MW	-2.64 kW...1.4 W ...2.64 kW	●	●	●	●	± 1%
Reactive power	-999 Mvar...0.00 var ...999 Mvar	-2.64 kvar...1.4 var ...2.64 kvar	●	●	●	●	± 1%
Apparent power	0.00 VA...999 MVA	1.4 VA...2.64 kVA	●	●	●	●	± 1%
Power factor PF	0.00 cap...1.00...0.00 ind	0.2 cap...1,00 ...0.2 ind	●	●	●	●	± 2%
Active energy	0...99 999 999.9 kWh					●	± 1%
Reactive energy	0...99 999 999.9 kvarh					●	± 1%

Ku - ratio of voltage transformer: 1... 4000
Ki - ratio of current transformer: 1... 10000

Power consumption:

- in the supply circuit	≤ 6 VA
- in the voltage circuit	≤ 0.05 VA
- in the current circuit	≤ 0.05 VA

Display field	3 × 3 LED digits 14mm height red colour
Relay output	relay, voltageless, NOC contacts load capacity: 250 V~/ 0.5 A~
Serial interface	RS-485
Transmission protocol	MODBUS RTU
Impulse energy output	output of O/C type, passive acc. to EN 62053-31
Impulse constant of the O/C type output	500 imp/kWh, independently of set ratio Ku, Ki

Protection degree ensured by the housing:

- from the frontal side	IP 40
- from terminal side	IP 10

Weight	0.3 kg
Dimensions	96 × 96 × 70.5 mm
Panel cut-out dimensions	$91^{+0.5} \times 91^{+0.5}$ mm

Reference conditions and rated operating conditions:

- supply voltage	85...253 V d.c. or a.c., 40...400 Hz
- input signal:	0...0.005...1.2 I_n; 0.05...1.2 U_n; for voltage, current 0...0.1...1.2 I_n; 0...0.1...1.2 U_n; for power factors Pf_i, $t\varphi_i$, frequency 45...65...500 Hz; sinusoidal (THD ≤ 8%)

- power factor	0...0.2 cap ...1...0.2 ind ...0
- ambient temperature	- 25...23...+55°C
- storage temperature	- 30... +70°C
- relative air humidity	25... 95% (condensation inadmissible)
- admissible peak factor:	
- current	2
- voltage	2
- external magnetic field	0... 40... 400 A/m
- short duration overload capacity (5 s):	
- voltage inputs	2 Un (max.1000 V)
- current inputs	10 In
- work position	any
- warm-up time	5 min.

Additional errors in % of the basic error:

- from frequency of input signals	< 50%
- from ambient temperature changes	< 50%/10°C

Standards fulfilled by the meter:

Electromagnetic compatibility:

- noise immunity acc. to EN 61000-6-2
- interference emission acc. to EN 61000-6-4

***Safety requirements acc to EN 61010-1 standard*:**

- isolation between circuits: basic,
- installation category III,
- pollution degree 2,
- maximal working voltage in relation to earth 600 V
- height over sea level, < 2000 m.

10. ORDER CODES

Table 9

NETWORK PARAMETER METER	N14 -	X	X	XX	X

Input current I_n

1 A (X/1) **1**

5 A (X/5) **2**

Input voltage (phase/phase-to-phase) U_n

3 × 57.7/100 V..... **1**

3 × 230/400 V..... **2**

3 × 400/690 V..... **3**

Kind of version

standard **00**

custom-made ..... **XX**

Additional requirements

without an extra quality inspection certificate..... **8**

with a extra quality inspection certificate..... **7**

acc. to customer's agreement* ..... **X**

* The version code is established by the manufacturer

ORDER EXAMPLE

The **N14-2-2-00-7** code means:

N14 – network parameter meter of N14 type

2 – input current 5 A (X/5)

2 – input voltage 3 x 230/400 V

00 – standard version

7 - delivered with an extra quality inspection certificate

11. MAINTENANCE AND WARRANTY

The N14 network parameter meter does not require any periodical maintenance.

In case of some incorrect operations:

1. In the period of 12 months from the date of purchase:

One should take the transducer down from the installation and return it to the Manufacturer's Quality Control Dept.

If the unit has been used in compliance with the instructions, the Manufacturer warrants to repair it free of charge.

2. After the warranty period:

One should turn over the transducer to repair it in a certified service workshop. The disassembling of the housing causes the cancellation of the granted warranty.

Spare parts are available for the period of five years from the date of purchase.

Our policy is one of continuous improvement and we reserve the right to make changes in design and specifications of any products as engineering advances or necessity requires and revise the above specifications without notice.

SALES PROGRAM

MEASUREMENT
CONTROL
RECORDING

- DIGITAL and BARGRAPH PANEL METERS
- MEASURING TRANSDUCERS
- ANALOG PANEL METERS (DIN INSTRUMENTS)
- ANALOG and DIGITAL CLAMP-ON METERS
- INDUSTRIAL and HOUSEHOLD CONTROLLERS
- CHART AND PAPERLESS RECORDERS
- POWER CONTROL UNITS and INVERTERS
- WATT-HOUR METERS
- AUTOMOTIVE DASHBOARD INDICATORS
- ACCESSORIES FOR MEASURING INSTRUMENTS (SHUNTS)
- MEASURING SYSTEMS (ENERGY, HEAT, CONTROL)
- CUSTOM-MADE MEASURING ELECTRONIC DEVICES.

WE ALSO OFFER OUR SERVICES IN THE PRODUCTION OF:

- ALUMINIUM ALLOY PRESSURE CASTINGS
- PRECISION ENGINEERING AND THERMOPLASTICS PARTS
- PRESSURE CASTING DIES AND OTHER TOOLS
- VARIOUS ELECTRONIC SUB-ASSEMBLIES (MSD TECHNOLOGY)

QUALITY PROCEDURES:
According to ISO 9001 and ISO 14001 international requirements.
All our instruments have CE mark.
For more information, please write to or phone our Export

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